Applied

Dr. Miller
Section B

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

R E P O R T

of

ELEVENTH ANNUAL AIRCRAFT ENGINEERING RESEARCH CONFERENCE

Section B

Under Auspices of the

National Advisory Committee for Aeronautics

Langley Field, Virginia

May 22, 1936

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

REPORT

of

ELEVENTH ANNUAL AIRCRAFT ENGINEERING RESEARCH CONFERENCE

Section B

Langley Field, Virginia
May 22, 1936

Section B of the Eleventh Annual Aircraft Engineering Research Conference of the National Advisory Committee for Aeronautics was held on Friday, May 22, 1936, at the Committee's laboratory, the Langley Memorial Aeronautical Laboratory, at Langley Field, Virginia. For the first time the conference was held in two sections. Section A, which was held on May 20, included in general the representatives of aircraft manufacturers and operators and Government officials. Section B included the personnel of governmental agencies using aircraft, representatives of engineering societies, members of the faculties of professional schools, and representatives of manufacturers and operators who were unable to attend Section A.

The purposes of this annual conference were twofold: First, to afford to the representatives of the industry an opportunity to receive first-hand reports of progress in aeronautical research at the Committee's laboratory and to witness demonstrations of the special facilities and methods used; and second, to enable the Committee to obtain the comments and suggestions of the industry as to the research problems which are deemed of particular importance at the present time and which the Committee is especially equipped to study.

The National Advisory Committee for Aeronautics was represented at Section B of the conference by its officers and also by its Committee on Aircraft Structures and Materials, its Subcommittee on Structural Loads and Methods of Structural Analysis, and by members of its laboratory staff.

Some of those attending Section B left Washington at 6:30 p.m., May 21, proceeding by overnight steamer to Old Point Comfort. Breakfast was served at the Chamberlin Hotel, Old Point Comfort, at 6:50 a.m. The party then proceeded by automobile to Langley Field, where they were joined by a large group who flew direct to Langley Field, and by others who arrived by auto and by train.

MORNING SESSION.

The opening session was held at 8:45 a.m. in the Post Theater at Langley Field, which was made available through the courtesy of the Commanding Officer of the Field.

The Chairman of the conference, Dr. Joseph S. Ames, Chairman of the National Advisory Committee for Aeronautics, was prevented by illness from being present, and in his absence Dr. Lyman J. Briggs, a member of the Committee, presided.

Brief addresses of welcome were made by the Presiding Officer on behalf of the National Advisory Committee for Aeronautics; and by Brigadier General Henry C. Pratt, Air Corps, Commanding Officer of Langley Field and also Commander of the Second Wing of the General Headquarters Air Force and a former member of the National Advisory Committee for Aeronautics.

The Presiding Officer then introduced Mr. Henry J. E. Reid, Engineer-in-Charge of the Langley Memorial Aeronautical Laboratory, who after a few words of greeting to the guests called upon certain members of the laboratory staff in turn to present and explain, with the aid of charts, some of the important results of investigations conducted by the Committee during the past year.

Mr. Elton W. Miller, Chief of the Aerodynamics Division of the laboratory, outlined in general the investigations being conducted by the Committee in the improvement of aerodynamic efficiency, including in particular the best methods of the application of airfoil data to wing design, wing-fuselage interference with elliptical and triangular fuselages, the optimum fuselage form, the effect of rivet heads on aerodynamic drag, and the effect of idling or stopped propellers on airplane lift.

Mr. Fred E. Weick, Assistant Chief of the Aerodynamics Division, discussed the Committee's study of stability and control of airplanes and exhibited charts of some of the results obtained.

Mr. Truscott, Chief of the Hydrodynamics Division, explained the investigations in the N.A.C.A. tank during the past year, including a study of the effect of rivet heads on take-off, the optimum shape of wing-tip float for large seaplanes, a comparison of the take-off performance of various European and American seaplane hulls, and a comparison of single-hull and double-hull flying boats.

Dr. Theodore Theodorsen, Chief of the Physical Research Division, discussed the investigation of the cowling and cooling of air-cooled engines, particularly the analysis of the many factors entering into the design of a successful N.A.C.A. cowling.

Mr. Carlton Kemper, Chief of the Power Plants Division, described some of the principal results of investigations of aircraft engines, including a comparison of the performance of carburetor-type and Diesel-type engines, a comparison of air cooling in flight and on a single-cylinder test engine, the effect of fin spacing on the cooling characteristics of an engine cylinder, and the variation in engine cylinder temperatures with variation in temperature of the cooling air.

Mr. John F. Victory, Secretary of the Committee, requested that the members of the conference consider the material presented at the conference as confidential. He also requested that during the inspection of the laboratory no photographs be made of any of the charts, although rough sketches might be made by individuals for their own information, but not for reproduction.

Mr. Victory announced that the party would divide into six groups for inspection of the laboratory according to the color of the tags which had been supplied to and were being worn by the guests. He said that those with red tags would be led by Dr. Briggs, those with white tags by Commander Fulton, those with blue tags by Captain Bogert, those with brown tags by Dr. Lewis, those with green by Mr. Victory, and those with yellow by Mr. Reid. He said that it was essential that the members of each group keep together, and that the schedule be followed strictly, in order to avoid confusion and delay.

The members of the conference then proceeded on a tour of inspection of the laboratory in accordance with the following program:

Arrive	Red	White	Blue	Brown	Green	Yellow
Propeller-Research Tunnel	9:45	12:33	12:04	11:38	11:09	10:40
8-Foot High-Speed Tunnel	10:11	9:45	12:30	12:04	11:35	11:06
Free-Spinning Tunnel	10:40	10:14	9:45	12:33	12:04	11:35
N.A.C.A. Tank	11:06	10:40	10:11	9:45	12:30	12:01
N.A.C.A. Hangar	11:35	11:09	10:40	10:14	9:45	12:30
Engine Laboratory	12:04	11:38	11:09	10:43	10:14	9:45
Variable-Density Wind Tunnel	12:30	12:04	11:35	11:09	10:40	10:11
Atmospheric Wind Tunnel	12:43	12:17	11:48	11:22	10:53	10:24

Propeller-Research Tunnel. At the propeller-research tunnel charts were shown of results obtained in the investigation of the effect on control and performance of a two-engine airplane after failure of one engine. The large model equipped with operating propellers, which was used in the investigation, was shown in test position in the tunnel. Results were also presented of the analysis of problems of propeller design, showing the efficiency likely to be obtained under various conditions.

Eight-Foot High-Speed Wind Tunnel. At the new eight-foot high-speed wind tunnel, which was opened for inspection for the first time, the principal design features of the tunnel were briefly described. It was stated that the tunnel proper had a working section eight feet in diameter and a range of air speeds from 85 miles per hour to 500 miles per hour and that the tunnel was operated by a 8000-horsepower electric motor

driving an 18-blade propeller 16 feet in diameter. Charts were shown of results obtained in the Committee's smaller high-speed wind tunnel of the pressures on propeller blade sections and the loss in energy corresponding to increased drag at very high speeds.

Free-Spinning Wind Tunnel. At the free-spinning wind tunnel charts were shown of the influence upon spins of the arrangement of tail surfaces; a comparison between spinning characteristics as determined by the spinning balance in the N.A.C.A. vertical wind tunnel, as observed in the free-spinning wind tunnel, and as determined in actual flight; and a method of the rapid estimation of lateral-stability characteristics of airplanes. Demonstrations were made in the tunnel of the spinning characteristics of a small pusher-type double-tail airplane with three-wheel landing gear and of a low-wing monoplane of modern type with and without the addition of a small area at various parts of the tail.

N.A.C.A. Tank. In the N.A.C.A. tank a model of a hull equipped with a hydrofoil was towed through the water and on an illuminated chart a curve was developed showing the improved drag characteristics of the model with the hydrofoil as compared with the same model without the hydrofoil, resulting in decreased time and distance of take-off. Charts were exhibited and shown of the effect on take-off of rivet heads on the bottoms of flying-boat hulls, and the effect of ventilating the step to improve take-off characteristics.

N.A.C.A. Hangar. At the N.A.C.A. hangar charts were shown of results obtained in the study of high-lift and lateral-control devices on full-scale airplanes, the investigation of the column strength of stiffeners for stressed-skin construction, and the measurement of accelerations on transport airplanes in gusty air. A demonstration was given of the effectiveness of a swiveling or castering wheel when placed below the airplane forward of the center of gravity in the prevention of ground looping.

Engine Research Laboratory. At the aircraft engine research laboratory charts were shown of results obtained in the investigation of the high-speed aircraft Diesel engine, and a single-cylinder engine of this type having a displacer form of combustion chamber was shown in

operation. A special glass-cylinder engine for the study of the mixture of injected fuel and air in a fuel-injection engine was exhibited. In this cylinder smoke is used to make the air movement in the cylinder visible during the suction and compression stroke and the air movement and fuel spray distribution are photographed by high-speed motion pictures.

Variable-Density Wind Tunnel. At the variable-density wind tunnel charts were shown indicating the development of a method for the rational selection of wing sections for airplane design according to the requirements of the airplane. A demonstration was given in the smoke-flow tunnel of laminar and turbulent boundary-layer flow and of the effect of rivet heads on the turbulence of the flow.

Atmospheric Wind Tunnel. A demonstration was given in the atmospheric wind tunnel of a tapered wing designed so that the center section of the wing stalled first instead of the tip section. In this demonstration the stalling characteristics of this wing were shown, as well as the stalling characteristics of an ordinary tapered wing which stalled first at the tip section. White silk tufts fastened at various places over the wing surface were used to indicate the character of the air flow, and the model as tested with both wings was mounted so as to be free to rotate and free to pitch about its center of gravity. It was shown that when the tips stalled first the model had a strong tendency to autorotation and spinning, whereas with the wing without tip stall this tendency was very greatly reduced.

At 1:00 p.m. all groups reassembled for lunch at the full-scale wind tunnel, after which, at 2:10 p.m., the entire party gathered in the test chamber of the full-scale wind tunnel where a group photograph was taken.

Physical Research. Charts were then shown presenting in greater detail the Committee's investigation of the factors involved in the design of a cowling and the new N.A.C.A. nose-type cowling was shown mounted on the front part of a fuselage.

Full-Scale Wind Tunnel. Charts were exhibited of the results of the Committee's investigation of the effect of aspect ratio for airship fins and of the forces on an airship in ground handling. Information was presented as to the effect of engine nacelles on the stall of highly tapered wings, on the effect of propeller slipstream upon the span loading of wings, and on the effect of locked and windmilling propellers with nacelles located in the leading edge upon the maximum lift coefficient.

Mr. Reid announced that seven simultaneous conferences would be held as was shown on the programs that had been distributed, for the discussion of seven different subjects. He indicated the place of meeting for each of these seven conferences, as well as an assembling point for those desiring to attend each. The party accordingly separated to attend the following simultaneous conferences:

I. Flying and Handling Characteristics

II. Aerodynamic Efficiency and Interference

III. Aerodynamic Consideration of Cowling and Cooling

IV. Power Plant Consideration of Cowling and Cooling

V. Airoraft-Engine Research

VI. Seaplanes

VII. Autogiro

CONFERENCE ON FLYING AND HANDLING CHARACTERISTICS.

The conference on flying and handling characteristics was held in Room A of the full-scale wind tunnel building at about 3:00 p.m. Mr. Elton W. Miller, Chief of the Aerodynamics Division of the Committee's laboratory, presided at this conference.

After a brief introductory statement by Mr. Miller the conference proceeded to the consideration of the subject, in accordance with the following outline:

1. Lateral control:
   New criterions for comparison
   Differential linkages
   Special wings with unstalled tips

2. Control forces that can be exerted by pilots

3. Lateral stability

4. Longitudinal stability - Measured stability compared with pilot's feel of stiffness

5. Take-off and landing with high-lift devices:
   Wind-tunnel data
   Flight results

6. Taxying stability

Charts showing results obtained by the Committee in connection with the various subjects in this outline were presented by Mr. Weick and other members of the Committee's technical staff. During the presentation questions were asked by the members of the conference and answered by the laboratory personnel, and suggestions for future work were submitted by guests.

Following the discussion, at about 5:00 p.m., the conference adjourned.

CONFERENCE ON AERODYNAMIC EFFICIENCY AND INTERFERENCE.

The conference on aerodynamic efficiency and interference was held in Room B of the full-scale wind tunnel building at about 3:00 p.m. Dr. L. B. Tuckerman, of the National Bureau of Standards, a member of the Subcommittee on Structural Loads and Methods of Structural Analysis, presided at this conference

Charts were presented and explained by members of the Committee's staff and the data covered by the charts were discussed. Questions were asked and suggestions for future work were submitted by the guests.

The discussion of the subject in general followed the outline given below:

1. Air-flow fundamentals - Scale effect
   Scale effect for the pressure distribution on an airfoil section
   The nature of the transition phenomenon and its relation to the drag scale effect
   Airfoil scale effect

2. Tapered wings - Application of section data to design of tapered wings

3. Improvement of airfoil sections and wing-fuselage combinations (interference)
   Airfoil section development
   Wing-fuselage interference

On conclusion of the discussion, at about 5:00 p.m., the conference adjourned.

CONFERENCE ON AERODYNAMIC CONSIDERATION OF COWLING AND COOLING

The conference on aerodynamic consideration of cowling and cooling was held in Room C of the full-scale wind tunnel building at about 3:00 p.m. Dr. George W. Lewis, Director of Aeronautical Research of the National Advisory Committee for Aeronautics, presided at this conference.

Charts were exhibited showing results obtained by the Committee in its study of the aerodynamics of cowling design. Dr. Theodorsen referred to these charts and invited questions as to the information presented therein. A number of questions were asked, to which replies were made by Dr. Theodorsen or others present.

The information presented at this conference included the following subjects:

1. Cowling nose design - Frontal opening

2. Skirt design - Regulation of air flow for cooling

3. Cooling as affected by cowling

4. Effect of propeller on cowling design

5. Effect of baffling of engine - Conductivity
6. Effect and use of spinners
7. Effect of inner cowl - Design of exit opening
8. Effect of size of nacelle or afterbody
9. "Pump efficiency"
10. Factors affecting cooling on the ground
11. Skirt flaps, large hub sections, fans, and blowers
12. New N.A.C.A. nose-type cowling

At the close of the discussion, at about 5:00 p.m., the conference adjourned.

CONFERENCE ON AIRCRAFT ENGINE RESEARCH.

The conference on aircraft engine research was held in the Engine Research Laboratory at about 3:00 p.m. Mr. A. M. Rothrock, of the Power Plants Division of the Committee's laboratory, presided at this conference.

Charts were exhibited and explained by members of the Committee's staff giving results obtained in the investigation of aircraft engines, particularly of the compression-ignition type. The data presented included information as to the new N.A.C.A. fuel flowmeter developed by the laboratory in connection with its investigation of the reduction of fuel consumption of aircraft engines. The subjects discussed at this conference were as follows:

1. Distribution and exhaust gas analysis
2. Compression-ignition engine research
3. Fuel-injection spark-ignition engines
4. Investigation of ignition and combustion of Diesel fuels

5. Rate of fuel injection

6. Reduction in fuel consumption - N.A.C.A. fuel flowmeter

CONFERENCE ON SEAPLANES.

The conference on seaplanes was held at the N.A.C.A. Tank at about 3:00 p.m. Mr. Starr Truscott, Chief of the Hydrodynamics Division of the Committee's laboratory, presided at this conference.

Charts were exhibited and explained by members of the staff of the N.A.C.A. Tank on the following subjects:

1. Effect of rivets on water drag of seaplane hulls

2. SVA type floats and hydrofoils

3. Ventilation of step of flying-boat hull

4. Wing-tip floats - Hydrodynamic characteristics

5. Wing-tip floats - Aerodynamic characteristics

6. Comparison of single-hull and double-hull designs

7. Comparison of stub wings and floats

8. Comparison of characteristics of improved designs of large seaplanes, both European and American

There was general discussion of the charts and of the problems of seaplane design. In addition to the subjects covered by the charts the following problems were discussed:

Hump resistance

Methods of conducting rough water tests - Investigation of loads on hulls

Controllability and maneuverability of seaplanes on the water - Effect of flaps on take-off

Protective coatings for hulls

Methods of studying flow over hull surfaces

Characteristics of bow shapes

Questions and suggestions for future research were submitted by members of the conference and replies made by representatives of the Committee.

Following the discussion, at about 4:50 p.m., the conference adjourned.

CONFERENCE ON AUTOGIRO.

The conference on the autogiro was held in the N.A.C.A. hangar at about 3:10 p.m. Mr. John W. Crowley, Jr., head of the Flight Research Section of the Committee's laboratory, presided.

Charts of results obtained by the Committee in its investigation of autogiros were presented and discussed. The following subjects were considered:

1. Stability of the autogiro rotor
2. Rotor efficiency
3. Fixed wing
4. Rotor vibration

Following the discussion, at about 4:10 p.m., the conference adjourned, to view motion pictures of the autogiro rotor blade taken in flight.

* * * * * * * * * * * *

At the close of the afternoon conferences, at about 5:00 p.m., the party, accompanied by members of the Committee's staff at Langley Field, proceeded by automobile

to the Chamberlin Hotel. At 7:00 p.m., the party left Old Point Comfort by steamer and arrived at Washington at 7:00 a.m., Saturday, May 23, 1936.

The following were present at the conference:

Officers of the National Advisory Committee for Aeronautics:

Dr. George W. Lewis, Director of Aeronautical Research,
Mr. John F. Victory, Secretary,
Mr. H. J. E. Reid, Engineer-in-Charge, L.M.A.L.

Members of Committee on Aircraft Structures and Materials:

[1]Dr. Lyman J. Briggs, National Bureau of Standards, Chairman,
Professor H. L. Whittemore, National Bureau of Standards, Vice Chairman,
Captain Howard Z. Bogert, Air Corps, U.S.A.,
Lieutenant N. A. Draim (C.C.), U.S.N.,
Mr. Warren E. Emley, National Bureau of Standards,
Commander Garland Fulton (C.C.), U.S.N.,
Mr. J. B. Johnson, Materiel Division, Army Air Corps, Wright Field,
[2]Dr. George W. Lewis,
Mr. H. S. Rawdon, National Bureau of Standards,
Mr. E. C. Smith, Republic Steel Corporation,
Mr. Starr Truscott, Langley Memorial Aeronautical Laboratory.

Members of Subcommittee on Structural Loads and Methods of Structural Analysis:

[3]Mr. Starr Truscott, Langley Memorial Aeronautical Laboratory, Chairman,
[3]Captain Howard Z. Bogert, Air Corps, U.S.A.,

---

[1]Also member of the N.A.C.A.
[2]Also officer of the N.A.C.A.
[3]Also member of the Committee on Aircraft Structures and Materials.

Lieutenant Commander L. M. Grant (C.C.), U.S.N.,
Captain C. F. Greene, Air Corps, U.S.A.,
[1]Dr. George W. Lewis,
Professor Joseph S. Newell, Massachusetts Institute of Technology,
Lieutenant Commander H. R. Oster (C.C.), U.S.N.,
[1]Mr. H. J. E. Reid, Langley Memorial Aeronautical Laboratory,
Mr. Richard V. Rhode, Langley Memorial Aeronautical Laboratory,
Dr. L. B. Tuckerman, National Bureau of Standards.

Representatives of the Army:

Flying Cadet C. B. Adair, U.S.A.,
Second Lieutenant Burton W. Armstrong, Air Corps, U.S.A.,
Captain G. O. Barcus, Air Corps, U.S.A.,
First Lieutenant J. E. Barr, Air Corps, U.S.A.,
Captain William C. Bentley, Air Corps, U.S.A.,
Captain J. A. Bulger, Air Corps, U.S.A.,
Second Lieutenant G. L. Cherymisin, U.S.A.,
Lieutenant William T. Colman, Air Corps, U.S.A.,
Private R. C. Dahlman, U.S.A.,
Lieutenant Frederick R. Dent, Jr., Air Corps, U.S.A.,
Captain H. W. Dorr, Air Corps, U.S.A.,
First Lieutenant Marcellus Duffy, Air Corps, U.S.A.,
Flying Cadet J. H. Eakin, U.S.A.,
Second Lieutenant A. G. Eubanks, Air-Res., U.S.A.,
Second Lieutenant M. A. Elkins, Air-Res., U.S.A.,
Colonel W. W. Ford, U.S.A.,
Captain D. F. Fritch, Air Corps, U.S.A.,
Second Lieutenant W. J. Garrison, Air-Res., U.S.A.,
Second Lieutenant Robert A. Gresham, Air-Res., U.S.A.,
Captain M. E. Gross, Air Corps, U.S.A.,
Captain R. A. Grussendorf, Air Corps, U.S.A.,
Captain D. D. Hale, Air Corps, U.S.A.,
Major Frederick M. Hopkins, Air Corps, U.S.A.
Second Lieutenant J. H. Jeffus, Air-Res., U.S.A.,
Second Lieutenant J. D. Lee, Air-Res., U.S.A.,
Colonel R. B. Lincoln, Air Corps, U.S.A.
Major W. E. Lynd, Air Corps, U.S.A.,
Second Lieutenant H. D. Martin, Air-Res., U.S.A.,
Colonel R. L. Maxwell, U.S.A.,
Colonel W. C. McChord, Air Corps, U.S.A.,
Lieutenant Howard M. McCoy, Air Corps, U.S.A.,

---

[1]Also officer of the N.A.C.A.

Captain George W. McGregor, Air Corps, U.S.A.,
Major Clements McMullen, Air Corps, U.S.A.,
First Lieutenant Joseph A. Miller, Air Corps, U.S.A.,
First Lieutenant Troup Miller, Jr., Air Corps, U.S.A.,
Lieutenant Charles K. Moore, Air Corps, U.S.A.,
Master Sergeant U. S. Nero, U.S.A.,
Second Lieutenant Glenn C. Nye, Air-Res., U.S.A.,
Captain Cornelius E. O'Connor, Air Corps, U.S.A.,
Second Lieutenant D. G. Ogden, Air-Res., U.S.A.,
Lieutenant Colonel Charles B. Oldfield, Air Corps, U.S.A.,
Captain F. M. Paul, Air Corps, U.S.A.,
Flying Cadet P. P. Pender, U.S.A.,
Lieutenant Edwin S. Perrin, Air Corps, U.S.A.,
Brigadier General H. C. Pratt, Air Corps, U.S.A.,
E. C. W. Pritchard, GHQ Air Force, Langley Field, Va.,
Captain David M. Ramsey, Air Corps, U.S.A.,
Colonel H. H. Richards, Air Corps, U.S.A.,
Lieutenant Pearl H. Robey, Air Corps, U.S.A.,
Captain S. O. Ross, U.S.A.,
Lieutenant Marshall S. Roth, Air Corps, U.S.A.,
Flying Cadet C. H. Rueter, U.S.A.,
Lieutenant Colonel William Ord Ryan, Air Corps, U.S.A.
Captain Dwight B. Schannep, Air Corps, U.S.A.,
Second Lieutenant J. C. Selser, Air-Res., U.S.A.,
Lieutenant Paul E. Shanahan, Air Corps, U.S.A.
Lieutenant F. H. Smith, Air Corps, U.S.A.,
Lieutenant W. F. Spurgin, U.S.A.,
Lieutenant Ralph P. Swofford, Air Corps, U.S.A.,
Flying Cadet M. E. Thayer, U.S.A.,
Second Lieutenant J. A. Thomas, Air-Res., U.S.A.,
Captain S. W. Towle, U.S.A.,
Major Otto G. Trunk, U.S.A.,
Major J. E. Upston, U.S.A.,
Major F. B. Valentine, Air Corps, U.S.A.,
Major J. F. Whitely, Air Corps, U.S.A.,
Flying Cadet Earl Willoughby, U.S.A.,
Captain H. E. Wilson, U.S.A.,
Lieutenant Colonel S. S. Winslow, U.S.A.,
Captain W. R. Wolfinbarger, Air Corps, U.S.A.,
First Lieutenant J. B. Zimmerman, Air Corps, U.S.A.

Representatives of the Navy:

Mr. W. A. Aberg, Bureau of Aeronautics, Navy Department,
Lieutenant (jg) W. H. Albach, U.S.N.,
Lieutenant M. E. Arnold, U.S.N.,
Mr. C. P. Baum, Bureau of Aeronautics, Navy Department,

Mr. R. E. Brown, Bureau of Aeronautics, Navy Department,
Mr. C. P. Burgess, Bureau of Aeronautics, Navy Department,
Lieutenant E. W. Clexton, U.S.N.,
Captain W. G. Child, U.S.N.,
J. C. Clark, A.C.M.M.,
Professor W. M. Coates, U. S. Naval Academy,
Lieutenant Commander T. S. Combs, U.S.N.,
Mr. R. L. Creel, Bureau of Aeronautics, Navy Department,
Lieutenant W. V. Davis, U.S.N.,
Lieutenant (jg) H. C. De Long, U.S.N.,
Mr. G. L. Desmond, Washington Navy Yard,
Lieutenant E. C. Dyer, U.S.N.,
Lieutenant (jg) E. H. Ecklemeyer, Jr., U.S.N.,
Lieutenant C. E. Ekstrom, U.S.N.,
Mr. George D. Evans, Norfolk Naval Air Station,
Lieutenant (jg) J. L. Ewing, Jr., U.S.N.,
Lieutenant Commander D. S. Fahrney, U.S.N.,
Mr. J. P. Fersinger, Bureau of Aeronautics, Navy Department,
Lieutenant A. P. Flagg, U.S.N.,
Mr. C. S. Fliedner, Bureau of Aeronautics, Navy Department,
Mr. J. M. Frankland, Bureau of Aeronautics, Navy Department,
Mr. J. N. Fresh, Washington Navy Yard,
Mr. L. J. Friedman, Bureau of Aeronautics, Navy Department,
Mr. W. S. Garland, Bureau of Aeronautics, Navy Department,
Mr. H. B. George, Washington Navy Yard,
Lieutenant (jg) C. D. Griffin, U.S.N.,
Lieutenant D. D. Gurley, U.S.N.R.,
Lieutenant (jg) J. A. Haley, Jr., U.S.N.,
Lieutenant Commander C. G. Halpine, U.S.N.,
Lieutenant D. W. Harrigan, U.S.N.,
Lieutenant C. L. Helber, U.S.N.,
Mr. R. H. Helmholtz, Washington Navy Yard,
Lieutenant (jg) H. T. Hodgskin, U.S.N.,
Mr. Henry I. Hoot, Naval Aircraft Factory,
Lieutenant (jg) F. N. Howe, U.S.N.,
Mr. H. J. Huester, Bureau of Aeronautics, Navy Department,
Mr. C. W. Hurley, Bureau of Aeronautics, Navy Department,
Mr. E. E. Johnson, Washington Navy Yard,
Lieutenant (jg) W. L. Kabler, U.S.N.,
Lieutenant S. King, U.S.N.,
Mr. E. F. Kroner, Norfolk Naval Air Station,

Lieutenant (jg) J. R. Lee, U.S.N.,
Mr. H. B. Lidoff, Washington Navy Yard,
Ensign E. F. Lorntz, U.S.N.,
H. B. Lynch, U.S.N.R.,
Mr. Peyton M. Magruder, Naval Aircraft Factory,
Mr. W. L. Martin, Bureau of Aeronautics, Navy Department,
Mr. I. W. Masters, Bureau of Aeronautics, Navy Department,
Mr. J. A. McCrary, Washington Navy Yard,
Lieutenant (jg) S. S. Miller, U.S.N.,
Mr. William H. Miller, Naval Aircraft Factory,
Lieutenant J. B. Moss, U.S.N.,
Lieutenant (jg) J. N. Murphy, U.S.N.,
Lieutenant E. T. Neale, U.S.N.,
Mr. E. P. Osborn, Bureau of Aeronautics, Navy Department,
Commander E. M. Pace, Jr., U.S.N.,
Lieutenant J. P. Pearson, U.S.N.,
Mr. R. H. Peterson, Washington Navy Yard,
Lieutenant (jg) C. J. Pfingstag, U.S.N.,
Lieutenant P. E. Pihl, U.S.N.,
Ensign L. D. Powell, U.S.N.,
Ensign W. M. Rakow, U.S.N.,
Mr. G. A. Rathert, Bureau of Aeronautics, Navy Department,
Mr. W. A. Ray, Bureau of Aeronautics, Navy Department,
Mr. F. E. Richardson, Office of Inspector of Naval Aircraft, New York City,
Lieutenant Commander L. B. Richardson, U.S.N.,
Lieutenant C. E. Roberts, U.S.N.,
Mr. W. H. Sapp,
Mr. F. J. Schmitt, Bureau of Aeronautics, Navy Department,
Lieutenant Commander M. F. Schoeffel, U.S.N.,
Ensign C. W. Schoenweiss, U.S.N.,
C. E. Shortridge, Chief Radioman,
Mr. T. W. Schwarzmann, Bureau of Aeronautics, Navy Department,
Captain J. M. Smeallie, U.S.N.,
P. Tesch, A.C.M.M.,
Lieutenant P. C. Treadwell, U.S.N.,
Lieutenant (jg) S. A. Van Every, U.S.N.,
Mr. G. T. Waite, Bureau of Aeronautics, Navy Department,
Lieutenant F. T. Ward, U.S.N.,
Lieutenant (jg) J. O. Wheat, U.S.N.,
Lieutenant Austin W. Wheelock, U.S.N.,
Mr. Karl H. White, Naval Aircraft Factory,
Lieutenant R. C. Young, U.S.N.

Representatives of the Marine Corps:

First Lieutenant E. E. Bard, U.S.M.C. (R),
First Lieutenant H. W. Bauer, U.S.M.C.,
Lieutenant (jg) T. D. Boaz, U.S.M.C.,
First Lieutenant L. H. Delano, Jr., U.S.M.C. (R),
Lieutenant Colonel R. S. Geiger, U.S.M.C.,
Captain B. F. Johnson, U.S.M.C.,
Master Sergeant H. R. Jordon, U.S.M.C.,
Captain B. E. Megee, U.S.M.C.,
First Lieutenant L. Norman, U.S.M.C.,
First Lieutenant G. D. Omer, U.S.M.C. (R),
Lieutenant C. A. Roberts, U.S.M.C.,
Captain C. F. Schilt, U.S.M.C.,
Captain J. N. Smith, U.S.M.C.,
Lieutenant D. W. Torrey, U.S.M.C.

Representatives of Engineering Societies:

American Physical Society:
Mr. William Howard Sanders,

American Society of Mechanical Engineers, Washington, D. C.:
[1]Mr. W. B. Ensinger,
Mr. John E. Graves,
Mr. Arthur E. Johnson,

Institute of Radio Engineers,
Mr. Robert R. Chamberlin,

Society of Automotive Engineers, New York City:
Mr. C. B. Veal,
Mr. C. B. Whittelsey, Jr.,

Society of Automotive Engineers, Washington, D. C.:
Mr. George A. Barker,
Mr. Bernard H. Benson,
Mr. A. H. Binyon,
Mr. Clarence F. Bruce,
[2]Mr. James Fulton Fox,
Mr. Paul S. Lane,
Mr. B. J. Lemon,
Mr. Edward Stead,
Mr. Phillip R. Wheeler.

---

[1]Also member of S.A.E.
[2]Also member of A.S.M.E.

Members of Faculties of Professional Schools:

California Institute of Technology, Pasadena, California:
Mr. W. C. Rockefeller,

Carnegie Institute of Technology, Pittsburgh, Pennsylvania:
Professor Allen H. Blaisdell,

Catholic University of America, Washington, D. C.:
Dr. Louis H. Crook,
Mr. J. D. Ferguson, Jr.,

University of Cincinnati, Cincinnati, Ohio:
Professor Bradley Jones,

University of Detroit, Detroit, Michigan:
Professor Peter Altman,

Georgia School of Technology, Atlanta, Georgia:
Professor T. Edward Moodie,

Harvard University, Cambridge, Massachusetts:
Professor J. P. Den Hartog,

Massachusetts Institute of Technology, Cambridge, Massachusetts:
Professor C. S. Draper,
Mr. J. Bicknell,
Mr. J. B. Kendrick,
Mr. W. F. Milliken,
Professor Shatswell Ober,
Professor E. S. Taylor,

University of Michigan, Ann Arbor, Michigan:
Professor F. W. Pawlowski,
Mr. B. L. Springer,
Professor M. J. Thompson,

University of North Carolina, Chapel Hill, North Carolina:
Professor Colin Carmichael,
Mr. J. A. MacLean,

University of Pennsylvania, Philadelphia, Pennsylvania:
Professor John A. Prior,

Pennsylvania State College, State College, Pennsylvania:
Professor K. DeJuhasz,

Polytechnic Institute of Brooklyn, Brooklyn, New York:
Dr. R. P. Harrington,
Mr. Edwin F. Miller,

Rensselaer Polytechnic Institute, Troy, New York:
Professor P. E. Hemke,
Professor J. G. Fairfield,

Stanford University, Palo Alto, California:
Professor E. G. Reid,

Tri-State College, Angola, Indiana:
Mr. W. E. Burnham,

Virginia Polytechnic Institute, Blacksburg, Virginia:
Mr. N. W. Conner,

College of William and Mary, Williamsburg, Virginia:
Mr. W. S. Foster,
Professor C. D. Gregory,
Professor W. G. Guy,
Professor J. W. Lambert,
Professor W. W. Merrymon.

Representatives of Manufacturers and Operators:

Aircraft Development Company, Washington, D. C.:
Mr. Willard A. Driggers,

Aircraft and Engine Development, Incorporated, Boston, Massachusetts:
Mr. Heraclio Alfaro,
Mr. Donald M. Came,

Aluminum Company of America, Pittsburgh, Pennsylvania:
Mr. L. C. Fisher (Washington, D. C.),
Mr. F. C. Pyne (Washington, D. C.),
Mr. E. B. Wilber (Washington, D. C.),

Baxter Manufacturing Company, Kansas City, Missouri:
Mr. Fred K. Baxter,

Central Airlines, Pittsburgh, Pennsylvania:
Mr. Charles Shoemaker,

Chrysler Corporation, Detroit, Michigan:
Mr. D. M. Borden,
Mr. H. A. Hicks,

Curtiss-Wright Airplane Company, Robertson, Missouri:
Mr. Albert E. Lombard,

Fairchild Aircraft Corporation, Hagerstown, Maryland:
Mr. George W. Hardman,
Mr. Orrin E. Ross,

Federal Industrial Corporation, Paterson, New Jersey:
Mr. R. L. Robiolio,

General Motors Research Laboratories, Detroit, Michigan:
Major G. E. A. Hallett,
Mr. T. S. McCrae,

Granville, Miller, and de Lackner, Springfield, Massachusetts:
Mr. Donald de Lackner,

Link Aviation Devices, Binghamton, New York:
Mr. E. A. Link,

Luscombe Airplane Development Corporation, Trenton, New Jersey:
Mr. A. E. Harbeck,
Mr. P. L. Salussolia,

The Glenn L. Martin Company, Baltimore, Maryland:
Mr. Ernest G. Stout,

Sensenich Brothers, Lititz, Pennsylvania:
Mr. Harry M. Sensenich,
Mr. Martin M. Sensenich,

Sinclair Refining Company, New York City:
Mr. G. French,

Skyways, Incorporated, East Boston, Massachusetts:
Mr. Crocker Snow,

Stewart Engineering Company, Akron, Ohio:
Mr. Earle Stewart,

Sun Shipbuilding and Dry Dock Company, Chester, Pennsylvania:
Mr. F. R. Maxwell,

Transoceanic Aerial Control System, Incorporated,
New York City:
Mr. Guido Chige,
Mr. Dan Galotti,
Mr. Rubino Plastino.

Special Guests:

Mr. Herbert L. Adams, Washington, D. C.,
Mr. C. M. Arhart,
Mr. Paul Brockett, National Academy of Sciences,
Mr. James P. Buchanan, Jr., Federal Communications Commission,
Mr. Edward E. Denniston, Germantown, Pennsylvania,
Mr. Owen Evans, Washington, D. C.
Mr. Charles P. Graddick, Air Mail Division, Post Office Department,
Reverend David C. George, American Legion,
Colonel H. E. Hartney, United States Senate,
Mr. S. R. Heller, American Legion,
Mr. A. C. Johnson, American Legion,
Mr. Robert E. Lees, Works Progress Administration,
Mr. W. L. LePage, Day and Zimmerman,
Honorable Melvin J. Maas, M.C.,
Mr. George Francis Myers, New York City,
Mr. H. H. Platt, New York City,
Honorable James G. Scrugham, M.C.,
Mr. C. I. Stanton, Bureau of Air Commerce, Department of Commerce,
Mr. L. D. Warrender, Casey Jones School of Aeronautics.